REMARKS

This is in response to the Office Action mailed on July 28, 2008, in which the following rejections were made:

1. Claims 1-3, 8, 10, 11, 16, 18, 21, 22, 27, 28, and 33 were rejected under 35 U.S.C. § 103(a) as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump, U.S. Patent No. 5,121,329 ("Crump") in view of Joseph et al., U.S. Patent No. 3,807,054 ("Joseph") or Edmonds, U.S. Patent No. 5,448,838 ("Edmonds");
2. Claims 4, 5, and 23 were rejected under 35 U.S.C. § 103(a) as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph/Edmonds and further in view of Dahlin et al., U.S. Patent No. 6,022,207 ("Dahlin").
3. Claims 19, 20, 36-39, 41, and 42 were rejected under 35 U.S.C. § 103(a) as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph/Edmonds and further in view of Leyden et al., U.S. Patent No. 5,143,663 ("Leyden").
4. Claim 40 was rejected under 35 U.S.C. § 103(a) as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph/Edmonds and further in view of Dahlin and Leyden.

With this response, claims 1, 11, 16, 18-21, and 33 are amended, claims 36-42 are canceled, and new claims 43-49 are added, such that pending claims 1-5, 8, 10, 11, 16, 18-23, 27, 28, 33, and 43-49 are presented for reconsideration and allowance.

I. Pending Claims 1-5, 8, 10, 11, 16, 18-20

The Office Action indicated that claims 1-3, 8, 10, 11, 16, and 18 were rejected under 35 U.S.C. § 103(a) as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph or Edmonds; claims 4 and 5

were rejected as applied above to claim 3, and further in view of Dahlin; and claims 19 and 20 were rejected as applied above to claim 1, and further in view of Leyden.

With this response, independent claim 1 is amended to recite that the object, which is built using a layered manufacturing rapid prototyping technique, includes an object surface having at least one surface effect due to the layered manufacturing rapid prototyping technique, where the at least one surface effect extends substantially across an entirety of the object surface, and where the at least one surface effect is selected from the group consisting of a stair step effect, striation, a roughness due to errors in building the object, and a combination thereof. As illustrated in FIG. 1 of the present application (reproduced below), three-dimensional objects built using a layered manufacturing rapid prototyping technique (e.g., fused deposition modeling) exhibit one or more surface effects due to the layered manufacturing rapid prototyping technique, where the surface effect(s) extend substantially across an entirety of the object surface (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20).

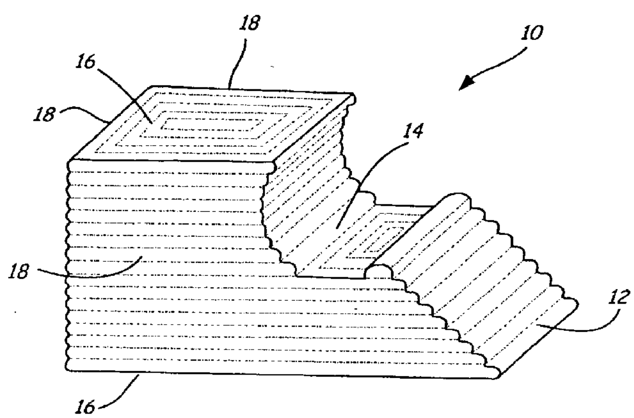

FIG. 1

For example, the object surface may exhibit stair-step effects created by the formation of successive layers, such as shown across angled surface 12 and curved surface 14 (present application, FIG. 1; page 2, lines 18-22; and page 6, lines 17-18). Additionally, the object surface may exhibit striation (e.g., texturing) created by formation of roads of the modeling material, such as shown across horizontal surfaces 16 and vertical surfaces 18 (present application, FIG. 1; page 2, lines 16-18; and page 6, line 20). Furthermore, the object surface

may also exhibit roughness in one or more locations due to errors in building the three-dimensional object with the layered manufacturing rapid prototyping technique (present application, FIG. 1; page 2, lines 23-30; and page 6, line 20).

Pursuant to the method of claim 1, the three-dimensional object may be exposed to vapors of a solvent that transiently soften the modeling material at the object surface, and the softened modeling material may reflow to reduce the surface effect(s). This reduces or eliminates the surface effect(s), which desirably provides a smooth surface (present application, FIG. 2, page 8, lines 10-16). This is further supported by the Declaration of Mr. Francisco Medina, which states that three-dimensional objects manufactured with RP/RM technologies have surface effects (e.g., stair stepping and striation) across their entire surfaces (Medina Declaration, ¶ 2). Mr. Medina also states that the vapor smoothing process reduces these surface effects and smoothes the entire exposed area (Medina Declaration, ¶ 2).

Crump, Joseph, and Edmonds, taken alone or in combination, do not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material. The Office Action initially stated that the admitted prior art teaches that an object built with a layered manufacturing rapid prototyping technique, such as the fused deposition modeling technique disclosed in Crump, exhibits a surface roughness effect that detracts aesthetically, and that manual/by hand techniques were known for smoothing the object surface (citing present application, page 2, line 16 to page 3, line 17).

However, the specification of the present application merely indicates that the conventional smoothing techniques involved manual trimming, machining, grinding, or sanding the objects to remove excess material (present application, page 3, lines 6-17). Neither the specification of the present application nor Crump disclose that surface effects due to the layered manufacturing rapid prototyping technique used may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface and reflowing the softened modeling material. Furthermore, as discussed in the Amendment of May 5, 2008, other smoothing techniques, such as those disclosed in

Leyden do not involve the use of a solvent vapor. Instead, Leyden discloses that the surface of the object is coated with an additional amount of resin to fill in the surface discontinuities, and the additional amount of resin is then cured to provide a smooth, solid surface (Leyden, col. 7, lines 1-15).

The Office Action further stated that it is extremely well known in the art that thermoplastic object surfaces formed as having a surface roughness, i.e., surfaces similar to or the same as those formed in the fused deposition modeling taught by the admitted prior art as exemplified in part by Crump, may be smoothed by exposing the object to vapors of a solvent such as methylene chloride that transiently softens the thermoplastic material at the object surface and reflows the softened thermoplastic material to uniformly smooth the object surface as shown by Joseph or Edmonds, it being further noted that the admitted prior art recognizes smoothing plastics with vapors of a solvent was known.

Applicants respectfully disagree with this contention. First, there is no teaching or suggestion in the prior art of record that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface and reflowing the softened modeling material. The specification of the present invention relied upon in the Office Action merely identifies the current problem with such surface effects, and conventional subtractive techniques for reducing the surface effects (e.g., trimming, machining, grinding, and sanding). None of these techniques involve the use of vapors of a solvent.

Furthermore, neither Joseph nor Edmonds disclose or suggest the use of three-dimensional objects built using layered manufacturing rapid prototyping techniques, or the reduction of surface effects due to a layered manufacturing rapid prototyping technique. Joseph are Edmond each directed to using vaporized solvents to remove scratches, dents, blemishes, and small voids in plastic articles, such as for refurbishing such articles (see e.g., Joseph, col. 4, lines 42-48; and Edmonds, col. 2, lines 43-51 and col. 3, lines 1-8). The Office Action contends that the surfaces of the articles smoothed in Joseph and Edmonds are similar to, or are the same as, the surfaces of articles built using a layered manufacturing rapid prototyping technique. However, as illustrated in FIG. 1 of the present application, the

surface effects due to the layered manufacturing rapid prototyping technique extend substantially across the entire surface of the three-dimensional object, including the bottom surface 16 (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20). This differs from surfaces merely having defects such as scratches, dents, blemishes, and small voids, or that merely require polishing. There is no recognition in Joseph or Edmonds, or any of the prior art of record to reduce surface effect(s) due to a layered manufacturing rapid prototyping technique, where the surface effect(s) extend substantially across an entirety of the object surface.

Moreover, three-dimensional objects built with layered manufacturing rapid prototyping techniques typically exhibit porous regions (Medina Declaration, ¶ 2). These porous regions are generally inherent in layered manufacturing rapid prototyping techniques due to the data generation and layer formation techniques. For example, when generating build paths for the sliced layers, small void regions may appear between generated paths due to resolution limitations. These void regions may result in small cavities being formed between the formed roads of the modeling material, which correspondingly increases the porosity of the resulting three-dimensional model. Such porosity may be present adjacent the object surface as well. The claimed method of exposing the object to solvent vapors that transiently soften the modeling material at the object surface and reflowing the softened modeling material also reduces the porosity of the three-dimensional model substantially across the entire object surface (Medina Declaration, ¶ 2). This reduced porosity potentially seals the exposed area, which may create water-tight three-dimensional objects that can withstand pressure buildup (Medina Declaration, ¶ 2).

In contrast, conventional smoothing techniques, such as trimming, machining, grinding, and sanding, may not necessarily reduce porosity since these techniques do not reflow the modeling material. Furthermore, the plastic articles that are smoothed pursuant to Joseph and Edmonds are typically built from an injection molding or similar technique, and do not exhibit such porosity issues. Thus, the combination of exposing the object to solvent vapors/reflowing the softened modeling material with the use of a three-dimensional object built with a layered manufacturing rapid prototyping technique provides porosity-reduction characteristics that are not present in, nor recognized by, the teachings of Joseph and/or

Edmonds, or any of the art of record.

Accordingly, the specification of the present application as exemplified in part by Crump, Joseph, and Edmonds, taken alone or in combination, do not disclose or suggest the limitations of independent claim 1. Thus, claim 1, and claims 2-5, 8, 10, 11, 16, and 18-20, which depend from claim 1, are not obvious over the specification of the present application as exemplified in part by Crump in view of Joseph and/or Edmonds, and are allowable.

With respect to claims 4 and 5, Dahlin also does not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material. Thus, claim 1, and claims 4 and 5, which depend from claim 1, are not obvious over the specification of the present application as exemplified in part by Crump in view of Joseph, Edmonds, and/or Dahlin, and are allowable.

With respect to claims 19 and 20, as discussed above for claim 1, Leyden also does not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material. Thus, claim 1, and claims 19 and 20, which depend from claim 1, are not obvious over the specification of the present application as exemplified in part by Crump in view of Joseph, Edmonds, and/or Leyden, and are allowable.

II. Pending Claims 21-23, 27, 28, and 33

The Office Action also indicated that claims 21, 22, 27, 28, and 33 were rejected under 35 U.S.C. § 103(a) as being obvious over the specification of the present application (pages 1-4 and 8) as exemplified in part by Crump in view of Joseph or Edmonds; and claim 23 was rejected as applied above to claim 22, and further in view of Dahlin.

With this response, independent claim 21 is amended to recite that the object, which is built from a plurality of layers using a layered manufacturing rapid prototyping technique, includes an object surface, where the plurality of layers create at least one surface effect extending substantially across an entirety of the object surface, and where the at least one

surface effect is selected from the group consisting of a stair step effect, striation, a roughness due to errors in building the object, and a combination thereof. Claim 21 also recites reflowing the softened modeling material to reduce the at least one surface effect across substantially the entirety of the object surface.

As discussed above for claim 1, Crump, Joseph, and Edmonds, taken alone or in combination, do not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the object surface, and reflowing the softened modeling material.

In addition, there is no teaching or suggestion in the prior art of record that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced substantially across the entirety of the object surface by exposing the object to solvent vapors that transiently soften the modeling material at the object surface and reflowing the softened modeling material. In particular, there is no recognition in Joseph or Edmonds, or any of the prior art of record to reduce surface effect(s) due to layered manufacturing rapid prototyping techniques, where the surface effect(s) extend substantially across an entirety of the object surface, or reducing the surface effect(s) substantially across the entirety of the object surface.

Moreover, three-dimensional objects built with layered manufacturing rapid prototyping techniques typically exhibit porous regions, which may be reduced with the method recited in claim 21 (Medina Declaration, ¶ 2). As discussed above, the combination of exposing a three-dimensional object to solvent vapors/reflowing the softened modeling material with the use of a three-dimensional object built with a layered manufacturing rapid prototyping technique provides porosity-reduction characteristics that are not present in, nor recognized by, the teachings of Joseph and/or Edmonds, or any of the art of record.

Accordingly, the specification of the present application as exemplified in part by Crump, Joseph, and Edmonds, taken alone or in combination, do not disclose or suggest the limitations of independent claim 21. Thus, claim 21, and claims 22, 23, 27, 28, and 33, which depend from claim 21, are not obvious over the specification of the present application as exemplified in part by Crump in view of Joseph and/or Edmonds, and are allowable.

With respect to claim 23, Dahlin also does not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced substantially across the entirety of the object surface by exposing the object to solvent vapors that transiently soften the modeling material at the object surface and reflowing the softened modeling material. Thus, claim 21, and claim 23, which depends from claim 1, are not obvious over the specification of the present application as exemplified in part by Crump in view of Joseph, Edmonds, and/or Dahlin, and are allowable.

III. Pending Claims 43-49

With this response, claims 43-49 are added. Independent claim 43 recites providing a three-dimensional object, which is built with a layered manufacturing rapid prototyping technique, to a vessel configured to contain vapors of a solvent, where the three-dimensional object has an exterior surface, and where substantially the entire exterior surface comprises at least one surface effect caused by the layered manufacturing rapid prototyping technique. The at least one surface effect is selected from the group consisting of a stair-step effect created by layering of a plurality of layers of the modeling material, striation created by formation of roads of the modeling material, surface roughness created by errors in the building of the three-dimensional object, and a combination thereof.

As discussed above, three-dimensional objects built using a layered manufacturing rapid prototyping technique (e.g., fused deposition modeling) exhibit one or more surface effects due to the layered manufacturing rapid prototyping technique, where the at least one surface effect extends substantially across an entirety of the object surface (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20). Pursuant to the method recited in claim 43, the three-dimensional object may be placed in the vessel in a manner that exposes substantially the entire exterior surface of the three-dimensional object to the vapors of the solvent (see e.g., present application, FIG. 3; and page 6, line 21 to page 7, line 12). This allows the vapors of the solvent to transiently soften the modeling material across the entire exposed exterior surface of the three-dimensional object (present application, FIG. 3; page 6, lines 21 to 32; and page 7, lines 12-15). The softened

modeling material may then reflow to reduce the at least one surface effect across the entire exposed exterior surface (present application, FIG. 2; page 7, lines 14-16; and page 8, lines 10-15; and Medina Declaration, ¶ 2).

As discussed above for claim 1, Crump, Joseph, and Edmonds, taken alone or in combination, do not disclose or suggest that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced by exposing the object to solvent vapors that transiently soften the modeling material at the exterior surface and reflowing the softened modeling material. In addition, there is no teaching or suggestion in the prior art of record that surface effects due to the layered manufacturing rapid prototyping technique used, such as the technique disclosed in Crump, may be reduced across the entire exposed object surface by exposing the object to solvent vapors that transiently soften the modeling material at the exposed exterior surface and reflowing the softened modeling material.

Moreover, three-dimensional objects built with layered manufacturing rapid prototyping techniques typically exhibit porous regions, which may be reduced with the method recited in claim 43. As discussed above, the combination of exposing a three-dimensional object to solvent vapors/reflowing the softened modeling material with the use of a three-dimensional object built with a layered manufacturing rapid prototyping technique provides porosity-reduction characteristics that are not present in, nor recognized by, the teachings of Joseph and/or Edmonds, or any of the art of record.

Accordingly, the specification of the present application as exemplified in part by Crump, Joseph, and Edmonds, taken alone or in combination, do not disclose or suggest the limitations of independent claim 43. Thus, claim 43, and claims 44-49, which depend from claim 43, are not obvious over the specification of the present application as exemplified in part by Crump in view of Joseph and/or Edmonds, and are allowable.

CONCLUSION

It is submitted that independent claims 1, 21, and 43 are in form for allowance. It is also submitted that the dependent claims 2-5, 8, 10, 11, 16, 18-20, 22, 23, 27, 28, 33, and 44-49 are in form for allowance as well due to their dependent nature. Reconsideration and

allowance of pending claims 1-5, 8, 10, 11, 16, 18-23, 27, 28, 33, and 43-49 are respectfully submitted.

The foregoing remarks are intended to assist the Office in examining the application and in the course of explanation may employ shortened or more specific or variant descriptions of some of the claim language. Such descriptions are not intended to limit the scope of the claims; the actual claim language should be considered in each case. Furthermore, the remarks are not to be considered exhaustive of the facets of the invention which are rendered patentable, being only examples of certain advantageous features and differences, which Applicants' attorney chooses to mention at this time. For the foregoing reasons, Applicants reserve the right to submit additional evidence showing the distinction between Applicants' invention to be novel and non-obvious in view of the prior art.

Furthermore, in commenting on the references and in order to facilitate a better understanding of the differences that are expressed in the claims, certain details of distinction between the same and the present invention have been mentioned, even though such differences do not appear in all of the claims. It is not intended by mentioning any such unclaimed distinctions to create any implied limitations in the claims.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

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